1 Introduction

Sign Language versus Gesture; Sign Language versus Speech

Abstract

By working through phonological questions using sign language data we arrive at a new understanding of the very nature of phonology, of the very nature of language. This chapter gives a brief historical look into the field from its inception, lays out the reasons why thinking about sign language phonology opens up new ways to understand the nature of language, broadly construed, and provides enough background on the units of word-level phonology in sign languages to see practical and theoretical connections to parallel issues in spoken language phonology.

1.1 INTRODUCTION TO THE TOPICS OF THIS VOLUME

Most non-linguists take phonology entirely for granted. As native language users we don't have as much metalinguistic awareness of the phonology of our language as we do about morphology and syntax, which are often taught explicitly in school. Children learn about the relationships between sounds and orthography in "phonics" but not about phonology – what the inventory of forms is or how they are combined. Most linguists know that there is a component of the grammar known as phonology, but often they are not sure what should be included there. And many phonologists do not often have to confront the question of what is or is not phonology unless they are doing language documentation and have to construct an inventory and set of constraints for a language that has not been previously studied.

What if those units were in a different modality entirely? How would we use our knowledge of how phonology functions as a system to decide which units are relevant and how they work together? In sign language we don't have as much disciplinary history as spoken language phonology. Our field is only about sixty years old.

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Although traditionally based on sound systems, phonology also includes the equivalent component of the grammar in sign languages, because it is tied to the grammatical *organization*, and not to whether the content is auditory-vocal or visual-gestural.

Phonology is the abstract grammatical component where primitive structural units without meaning are combined to create an infinite number of meaningful utterances. These units are also manipulated by language users to communicate their language identity and are implicated in historical change. This definition helps us see that the term "phonology" covers all phenomena organized by constituents such as the syllable, the phonological word, and the higher-level prosodic units, as well as the structural primitives such as features, segments, timing units, and autosegmental tiers, but it does not refer to the vocal or manual medium in which these structures are expressed.

In this volume we will look at sign language phonology from several vantage points, as if looking at it under a microscope from different angles and with different lenses. Often the topic of sign language phonology is introduced by comparing sign language structure to that of spoken languages: "Spoken languages have 'x'; sign languages either do (or do not) have 'x'." In this chapter, we will start out from a different place, based on conversations I have had over the years with those who have doubts about whether sign language has phonology at all. The answer is "yes, it does," but this question lingers because the medium is so unfamiliar.

For the purposes of this volume, a sign language is any one of the more than 200 known manual languages used in the deaf[1] communities of the world. They are produced on the hands, as well as on the face and body. They are shared within a community, they are passed down from one generation to the next, and they serve all of the linguistic and cultural functions that one would expect of a language. If there is a system used for limited purposes, or as a surrogate for speech, it is not included within this designation. An

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[1] A comment is needed here about the use of "Deaf" versus "deaf" in this book. "Deaf" has been used for several decades when discussing the cultural identity of an individual or community, and "deaf" when discussing the biological definition of hearing loss. I will follow Kusters' (2017) rationale and use "deaf" for all kinds of deaf people in this book. The "D/d" distinction is still important, but as deaf people from an ever wider range of backgrounds are included in academic discourse, the range of terms will become more nuanced, and the binary distinction D/d may not always be appropriate. Instead, groups of signers will therefore be described in prose as they arise.

example of such a surrogate system (not a natural sign language) is the one used in the Walpiri community by hearing women who grew up speaking Walpiri. They use a manually coded version of spoken Walpiri during their rather long period of mourning after they become widows (Kendon, 1980, 1984, 1985, 1987, 1988). Other such systems include manually coded systems of spoken languages throughout the world – e.g., Signed English, Signed French, Signed German, Signed Italian. These systems use signs, sometimes imported from a natural sign language, such as American Sign Language (ASL), but they are used in the service of representing the surrounding spoken language via signs, and they include invented forms to force the grammar to conform more closely to the spoken language. They have sometimes been employed in educational settings to teach the written language of the surrounding hearing communities. These surrogates and invented systems are not considered here.

This first chapter of *Sign Language Phonology* will be divided into two sections – the first addresses differences and similarities in sign and gesture, the second addresses differences and similarities between sign and speech, highlighting some of the historical moments when sign language phonology has had an important role in contemporary debates. The perspective taken in this chapter and in this volume is largely that of generative linguistics. Some of the debates that will be covered in this chapter and in subsequent ones include: Is language handled by a separate network in the brain or by general cognitive abilities? Did language arise in historical time in a gradual way or in an abrupt way? How does the critical period for language affect other areas of competence, such as learning to read?

Even if you are already up to date with the principles of sign language phonology and the history of the field, you still might want to read this first chapter for a fresh perspective of these issues. Consider this short volume as a conversation about sign language phonology. The volume cannot be exhaustive, but it is instead a way to highlight from my perspective those points that make sign language relevant beyond the small group of people in the trenches, people who are specialists. We will cover modality issues, iconicity, interface phenomena, acquisition, processing, language emergence, and variation, all with an eye to what makes them phonologically interesting to linguists, psychologists, anthropologists, historians of science, and child development specialists.

1.2 HISTORICAL PERSPECTIVES ON SIGN LANGUAGE PHONOLOGY

Our disciplinary perspective on sign language phonology has relied heavily on empirical methodology and evidence, because at the start it was important to disprove some naïve pronouncements by some important linguists about sign languages as a simple development from gesture. Sapir wrote, "sign languages are … in the same category as the gestures of Trappist monks vowed to perpetual silence and the gesture language of the Plains Indians of North America" (Edward Sapir, 1921:21, from Padden & Humphries, 1990). This was incorrect, because we know now that Cistercian and Trappist monks' use of signs is more similar to a surrogate, such as Signed English, since monks follow the word order of the spoken language with which they are most familiar (Barakat, 1975). Bloomfield wrote, "[It] seems certain that these gesture languages are merely developments of ordinary gestures and that any and all complicated or not immediately intelligible gestures are based on the conveniences of speech" (Leonard Bloomfield, 1933:39). This is also incorrect.

Moving to the American Structuralist period in the history of linguistics, Charles Hockett (1960, 1978) held fast to the view that his more "narrow" definition of language should include only those expressed by the vocal/auditory channel. Sapir, Bloomfield, and Hockett needed to be challenged, and challenging such respected voices required sign language researchers to be very careful and convincing in constructing their arguments. These arguments involved system internal evidence, such as distributional patterns, and system external evidence from psycholinguistic experiments, sign errors, variation, the study of language deficits after brain damage, and, eventually, neuroimaging. This volume is, in part, a testament to this strong empirical legacy.

One key moment in changing previously held ideas of sign language phonological structure occurred in the early 1960s–1970s, when Hockett (1960) proposed his design features of language. They were subsequently discussed in the context of sign languages. One topic that has been of ongoing interest in these discussions concerns the design feature *duality of patterning,* which will be defined here as two levels of structure with independent organization, typically phonology and morphology. An English example of this phenomenon is *cans*, which has two morphemes (the stem *can* and the plural morpheme *s*) but one syllable (the vowel *a* is the peak flanked by its onset *c* and the coda cluster *ns*). Sign languages show duality of patterning also.[2] In ASL,

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[2] The only phonological fact you need to know to understand this example is that movements are syllable nuclei in sign languages.

Figure 1.1 The two ASL stems THINK (left) and SELF (center), which form the compound THINK^SELF (*decide for oneself*, right). The compound (right) has two morphemes but just one syllable, just one movement. (Reprinted from *A Prosodic Model of Sign Language Phonology,* by Brentari, D., Copyright (1998), with permission from MIT Press.)

many compounds retain remnants of two stems but surface as a single syllable. The compound THINK^SELF, meaning *decide for oneself* (Figure 1.1), is composed of the two stems THINK and SELF (two meaning units), but instead of the full forms, each with independent movements, the compound consists of just one syllable (a single movement).

Another discussion associated to Hockett's design features focused on the inclusion of the vocal-auditory channel as a design feature for language, already mentioned in the previous section. The only phonological works on sign language phonology by this time were Stokoe (1960), Stokoe et al. (1965), and Frishberg (1975). Hockett (1978) was reluctant to state publicly that signed and spoken languages were equivalent, most likely because his main interlocutors were concerned primarily with the evolution of language rather than the equivalence between signed and spoken languages. In his oral lectures on the topic, Hockett acknowledged that "for its human users it [Ameslan] is as much like language as it could be given the difference of channel," and he says that there is clear evidence that ASL arose autonomously from English. But Hockett also states that he finds no evidence of duality of patterning in the communication of the chimpanzee, Washoe, or in other apes who had been reported to use a sign language, and Hockett still places a lot of emphasis on the effects of the vocal-auditory and manual-visual channels on the kinds of structures that emerge.[3] At the time, there was a great interest in the

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[3] I am profoundly grateful to Robert Ladd for discussing Hockett's writings and lectures of this period with me.

ape-language experiments, and Hockett's caution is understandable to some extent. His mention of the chimpanzee-subject, Washoe, suggests that he was worried that, given the little we knew about sign languages at the time, it would be too easy to conclude that if nonhuman primates, such as Washoe, Nim Chimsky, or Koko, used ASL, and assuming that ASL is a language, then nonhuman primates "have" language. We know much more about sign languages today than we did in 1978, and while nonhuman primates have been taught with great effort to use some limited aspects of language, we are now able to describe the differences between the linguistic competence of humans and higher-order primates with much more precision, both in quantity and quality (Savage-Rumbaugh, 1986).

1.3 SIGN LANGUAGE AND GESTURE

This volume describes the inner workings of the phonology of sign language and how this information has informed other fields of study. But the question that must be addressed first, at least for most non-specialists, is how sign language differs from other types of manual gestures. Duality of patterning is a powerful criterion to separate gesture from sign language, but based on Ladd (2014), phonology displays duality of patterning only in a minority of cases for spoken languages, so it is clear that phonology can be present even without duality of patterning. Following this line of argumentation, duality of patterning might be broken down into component elements. I will argue in Chapter 8 that principles such as MAXIMIZE CONTRASTS (DISPERSION), SYMMETRY within the phonological inventory, and other well-formedness constraints involving ALIGNMENT and FAITHFULNESS gradually help organize the system in historical time, but they do not emerge all at once, and these eventually lead to duality of patterning and minimal pairs.

Goldin-Meadow and Brentari (2017) have proposed relative properties that distinguish gesture from sign language. The properties converge around the larger point that gesture does not take on the primary burden of communication but is rather parasitic on a given language. Goldin-Meadow and Brentari make the argument that the true comparison between signed and spoken languages is not between speech versus sign alone but rather between speech+gesture versus sign+gesture. Yes, like speakers, signers produced gesture in parallel with the linguistic message. Gestures produced along with speech are "co-speech" gestures, while gestures produced along with sign language are "co-sign" gestures.

"Silent gesture" is another kind of gesture discussed later in this chapter and is what hearing non-signers do when they communicate without their voices – e.g., across a noisy, crowded room or when requested to do so in a laboratory setting. The reason why it is easier to determine what is language and gesture in spoken languages is because they often (not always) appear in very noticeably different modalities (auditory-language for language; visual-gestural for gesture), while sign language and gesture occur in the same (visual-gestural) modality. It is challenging but nevertheless possible to separate gesture from language in each modality.[4]

- Gesture **lacks hierarchical combinatorial structure**. Gestures may have compositional structure, but their combinations are characterized by a flat structure, whereas the combinatorial system that characterizes spoken and signed languages is hierarchical and interfaces many levels of grammar. This applies both broadly across the grammar and specifically to phonology, as we will see later in this chapter.
- Gesture is more **gradient** than language. Gradience per se is not a sufficient marker of gesture. There is a great deal of gradient variation in speech and sign; however, the gradience in language is anchored to a language's phonological and morphophonological categories, while gestures are not so constrained (see Duncan, 2005).
- Gestures are more **variable** than language. Sign languages have an established lexicon, while gestures do not, even though there are many gestural inventories that have been compiled. Popular bookstores are full of compilations of gestural inventories, both culturally specific ones and those that occur in many different cultures. Many such books typically contain emblematic gestures – e.g., the *shush* or *thumbs up* gesture (US emblems), or the *I-don't-care* or *pay-attention* gesture (Italian emblems).
- Co-speech and co-sign gestures are often produced **below the level of awareness** of speakers and signers, and access implicit, non-declarative knowledge. It has been shown, for example, that

[4] Even though here we will focus on visual gestures made with the hands and body, it is important to point out that auditory forms can be gestural as well (Haiman, 1980; Okrent, 2002; Shintel, et al., 2006; Grenoble et al., 2015). Both Okrent (2002) and Emmorey and Herzig (2003) argue that all language users (speakers and signers) instinctively know which part of their words can be manipulated to convey analog information. English speakers know that they can say *l-o-o-o-ng,* and not **l-l-l-ong or *lo-ng-ng-ng,* and ASL signers also know which parts of a handshape can be manipulated to convey the iconic properties of a scene while retaining the phonological characteristics.

co-speech and co-sign gestures are a window into the mind and tell us, for example, that children are in a state of transition within the trajectory of a particular learning process (Church & Goldin-Meadow, 1986; Goldin-Meadow et al., 2012). For example, the gestures of both speaking and signing children are important in identifying the moment when a child is on the brink of learning particular concepts in math.

• A phonological system distributes its contrasts in principled ways to exploit the whole of the articulatory and perceptual space in an organized fashion (for spoken languages, see Boersma, 2003, Downing et al., 2004, van 't Veer, 2015; for sign languages, see Eccarius, 2008, Brentari et al., 2017).

"Silent gestures" produced by hearing people are qualitatively different from co-speech gesture. Silent gesture (as opposed to co-speech gesture) is not parasitic on language and can take on the primary burden of communication for hearing people but primarily in atypical circumstances when speakers cannot speak. Hearing people might communicate this way across a crowded, noisy room. For example, if I want you to meet me at the car, I might gesture – *point-to-you, point-to-me, mimic driving.* Silent gesture is an important laboratory technique frequently employed to encourage hearing people to use their gestural competence to express themselves via gesture alone, when it bears the full burden of communication, in order to better understand how strings of gestures are, or are not, different from signs. Co-speech gestures typically occur at a rate of one gesture per clause; instead, silent gestures can be combined in a sequence, which is helpful when comparing them with a string of signs. In addition, Singleton et al. (1993) and Goldin-Meadow et al. (1996) found that gestures produced without speech by American gesturers were different than co-speech gestures in two ways. As just mentioned, silent gestures occurred in strings, and these strings of gestures were characterized by a consistent (non-English) order. Also in silent gestures, handshapes were more likely to express something about the shape of the object together with a movement, while co-speech gestures do this less often. One important step in becoming a language therefore is when the modality accepts the full burden of communication.

Silent gesture is not a sign language. It has no lexicon – forms are created on the spot – and importantly for this volume, it has no phonology, as determined using several criteria. Brentari et al. (2012, 2017) have shown that gestures concentrate all of their handshape distinctions and complexity in one kind of handshape.

In contrast, sign languages not only have a wider range of contrasts, they also symmetrically divide the distinctions they make in a more balanced fashion across the inventory of handshapes at their disposal (Brentari et al., 2017). Silent gestures, except for emblems, also have no rules of well-formedness (Kendon, 2004). A more in-depth discussion of this will occur in Chapter 5 on the emergence of phonology.

1.3.1 Neuroimaging

An important kind of evidence for a phonological system in a sign language comes from neuroimaging, which will be addressed at length in Chapter 6 on phonological processing. Of course, a fundamental question about the neural organization of sign language is whether it has the same areas of activation as spoken languages. The short answer is that it does; sign languages activate many of the same neural networks as spoken languages. And crucially, gesture and sign language activate the brain in different ways. Here we foreshadow that discussion.

MacSweeney et al. (2001) studied differences in neural activity in fluent signers (hearing and deaf) when they were watching (perceiving) British Sign Language (BSL) sentences versus rapid complex sequences of gestures from a system called TicTac used at racetracks to communicate about betting odds across long distances. The deaf signers (not hearing signers) showed greater activation for BSL than TicTac in the frontal lobe and superior temporal regions—see Figure 6.11 for illustrations. The superior temporal cortex, including the primary auditory cortex and Heschl's gyrus (Areas 41 & 42), is associated with phonological processing for spoken languages and is understood to be recruited to a greater extent when phonological structure is present in spoken languages (Woods et al., 2011). This would therefore explain the native deaf signers' results: BSL sentences are phonologically structured while TicTac is not. In deaf signers, sign language is therefore associated with greater activation in the areas of the brain used for spoken language phonological processing (Petitto et al., 2000; Scott & Johnsrude, 2003).[5]

Neural activation patterns also differ for deaf native signers and hearing non-signers when they are looking at the same meaningful

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[5] Bavelier et al. (2001) reported significantly greater activation in posterior superior temporal sulcus (STS) in deaf than hearing native signers in response to nonlinguistic motion stimuli as well, so sign language exposure may not be the only factor that determines activation in superior temporal regions.

iconic forms (Newman et al., 2015). This research team used functional magnetic resonance imaging (fMRI) to test deaf native ASL signers and hearing native English-speaking non-signers while they watched video clips containing ASL verbs of motion constructions describing the paths and manners of toy movement (e.g., a toy cow falling off a toy truck) and gestured descriptions of the same events, which look very similar (see Figure 5.1 for examples of similar types of event descriptions in sign and gesture). Among other findings, their results showed that three particular cortical areas – the left, inferior frontal gyrus (IFG, Area 44), the supramarginal gyrus (SMG, Area 40), and the superior temporal sulcus (STS) bilaterally – showed activation in signers and non-signers. This provides some evidence that symbolic communication in both sign language and gesture is capable of activating similar regions. However, there was greater activation in left IFG in signers when viewing linguistic content.

1.3.2   Conventionalization

To summarize this section, let us consider Saussure and the relation between the signified (concept) and the signifier (form; Figure 1.2). This volume encourages us to examine the plane containing options for phonologization *between* concept and form from the point of view of sign languages. This plane concerns how form becomes conventionalized, which can take many different routes. Not all of them are purely arbitrary. A phonological form can (and often does) become conventionalized for nonarbitrary reasons. For example, phonetic motivations can be part of the process of conventionalization – i.e., making forms easy to perceive or produce can be a part of the process. Just because a process is related to ease of articulation does not exclude it from the phonology. Many "weakening" processes in spoken languages (e.g., $/p/ > /f/ > /h/$) can be partially explained by ease of
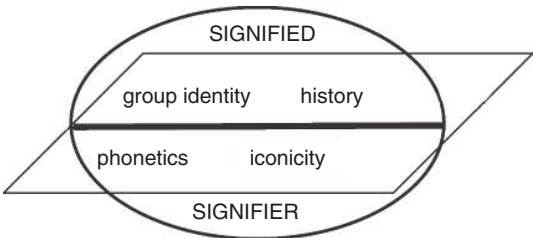

Figure 1.2   Possible mechanisms that can facilitate conventionalization of the signifier-signified relationship